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ABSTRACT

The impact of an inquiry approach on both teaching and learning in a technology-rich grade-1 classroom participating in the Cooperative Alliance for Gifted Education (CAGE) is described. CAGE is a partnership project that combines the resources of the Cleveland (Ohio) public schools, Kent State University, and International Business Machines Corp. Data were collected in the first 2 years of a larger study from a teacher, eight students, and their parents, who were interviewed about changes resulting from inquiry learning through using classroom computers. Teachers' log entries and student projects were also analyzed. Analysis uncovered the learning domains of thought processes, collaboration (social interaction), and attitude (confidence and interest). Change in these areas was evident to teachers, students, and parents. Technology itself appeared to be a factor in the development of student thinking and in the development of teacher attitudes. Three tables and two figures illustrate the discussion. (Contains 23 references.) (SLD)

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The Impact of an Inquiry Approach to Learning in a Technology-Rich Environment

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School reform initiatives such as Goals 2000 (U. S. Department of Education, 1993) call for increased student competency with challenging subject matter. Inquiry learning is one vehicle whereby students engage in challenging explorations and problem solving in areas of particular interest. Grounded in the pioneering work of Stauffer (1969), inquiry learning "provides an instructional environment in which students of varying abilities can work together naturally and meaningfully, where each individual can contribute to the success of the group" (Padak, 1988, p. 18). Olson (1985) suggested that as "tools of the intellect," classroom computers alter the way students think. In their seminal work, Scardamalia, et al., (1989) found it was possible to design a computer environment that provides the structure and tools that enable students to maximize use of their thinking and knowledge. However, Hawisher and Selfe (1991) cautioned that computers do not automatically create ideal learning situations; but as teachers become learners within a community of learners, the full potential of computers may be realized.

Technology has most often been used to deliver instructional content through drill and practice, tutorials, demonstrations, or simulations. "Using technology as the medium of instruction has to date been the most common focus in classrooms (Dyrli & Kinnaman, 1994). But when coupled with inquiry learning, technology becomes a tool that helps students create their own products. Throughout the inquiry process, computers may be

authentically used by students to organize information, keep records, and present findings to others (Padak & Peck, 1991). This authentic use reflects real-life functions and exhibits students' growth with genuine rather than artificial products. Using computers this way also helps "lead students to a clearer understanding of the place and significance of information in society" (Lockard, et al., 1994).

Earlier investigations of the effects of word processing on children's learning identified social context as a critical factor (Cochran-Smith, 1991). Dickinson (1986) studied social interactions during collaborative computer writing in a first-second grade classroom, noting in particular the different communicative demands presented by computer writing. Looking at collaborative computer writing in a first grade classroom from within the writing activity itself, Heap (1989) found the "other" person was a significant factor. Further, social aspects of computer use, such as equity issues have also been explored (Mehan, 1989).

This paper describes the impact of an inquiry approach on the teaching and learning in one technology-rich grade one classroom participating in the Cooperative Alliance for Gifted Education (CAGE; Shaklee, Barton, Padak, & Johnson, 1990). CAGE is a partnership project combining the resources of the Center for School Improvement of Cleveland Public Schools, the EduQuest Corporation of International Business Machines, and the College of Education of Kent State University. Project goals include the

development of an inquiry approach to teaching and learning embedded within authentic use of computers as learning tools.

Through an extensive review of research, Cochran-Smith (1991) found a need for long-term, naturalistic, qualitative studies to determine how teaching and learning change when computers are used in the classroom. This action research study addresses that need by extending previous work on first graders' use of computers as classroom tools (Peck & Hughes, in preparation) and children's language learning in a technology-rich environment (Peck & Hughes, in review). This systematic inquiry of everyday classroom actions brings a sociocultural perspective (Cochran-Smith and Lytle, 1993; Weade and Green, 1989) to classroom studies by examining the actions from the perspective of those experiencing them. Specifically, this study sought to describe learning outcomes for both the teacher and students in this inquiry-oriented, technology-rich classroom.

Method

Data for this study was collected during the first two school years of the larger study (CAGE; Shaklee, et al., 1990). Informants included the classroom teacher, eight students and their parents. The teacher was interviewed upon entering the project and each subsequent spring. The semi-structured, open-ended questions focused on her perceptions of project goals, possible barriers, and successes, particularly as related to classroom outcomes. She also reflected on changes she observed while viewing videotapes made of her students engaged in inquiry

learning using classroom computers; her reflections were audiotaped and later transcribed for analysis. Four students and their parents were interviewed each spring. They were asked if they noticed changes in the classroom (e.g., kind of work, ways of working) since using the computers, and they were also asked to describe what they liked or disliked about classroom computer use.

The researchers collaborated in the data reduction and analysis procedures. The process first involved identifying data congruent with the research goals, a procedure facilitated by the software program, *Ethnograph* (Seidel, Kjolseth, & Seymour, 1988). All interview and reflection transcriptions were searched for portions addressing the focus of this study. Quotations and enough of the conversational context to preserve understanding were coded for subsequent analysis. These reduced data were then combed for patterns or regularities (Goetz & LeCompte, 1984; Lincoln & Guba, 1985). Inductive analysis uncovered tentative categories, which were refined through the constant-comparative method (Glaser & Strauss, 1967).

Secondary data sources such as teacher log entries and field notes supported findings in these categories. Student product was also collected to further document learning outcomes. Additionally, data collected through pre/post self-assessments on classroom climate and attitude toward technology that the teacher completed each spring were analyzed for patterns.

Results

Analysis uncovered three domains that described learning outcomes in this inquiry-oriented, technology rich classroom. Table 1 displays their distribution by domain and across types of informants as percentage of the total comments. The data source and year collected are indicated parenthetically throughout the following discussion of results. All types of informants supplied comments in all three domains. The teacher supplied 83% of the comments made within the domain of thought processes and 77% of all comments within the collaboration domain. This suggests changes in thinking and social patterns were frequently observed by the teacher. Parents supplied 57% of all comments within the attitude domain but only 7% of comments addressing thinking and 2% of comments addressing collaboration. Understandably, changes in student attitude were more readily observed in the home, whereas changes in thought processes or social interaction were more likely to be observed in the classroom. Student comments were not of great frequency; however, they were supplied in each of the three domains.

Thought Processes

Changes in thinking were repeatedly identified by the teacher. Three general categories emerged from analysis of comments within this domain: technology as a tool, interaction with information, and student achievement.

Even as the project began, this teacher planned for the computer to be a tool integrated within the curriculum. She felt

one major goal of the project was to "incorporate it as a regular part of the classroom experience, so that as the children use it...they really perceive it as a tool that will enhance their ability to problem solve" (interview, 1991). The following year she commented, "I think too that it enhances the children's success in school because they...see it as an integral part of their lives, as compared to just an addition to the curriculum" (interview, 1992). Still one year later she felt "the project is showing that the technology can be better used in the classroom [rather than a computer lab] where the children can...integrate that use in the curriculum" (interview, 1993).

In this classroom, the teacher felt technology functioned as a thinking tool: "Somehow the computer...really has helped conceptualize a lot of the ideas and concepts that I have been teaching" (interview, 1992). She also saw the technology as compensating for reading difficulties by engaging students in higher order thinking through multi-media resources; if technology

> can enhance their abilities to think, then the fact that they can't read as well as I like them to really would not be an issue...if they can interact with a variety of media, if they can formulate questions and answer questions and go places to get the answers, all of that is going to expand their abilities when it does kick in for them to read. (interview, 1993)

The teacher observed differences in her students' thinking patterns: "They're just beginning to sort things out differently...they're able to look at things from different angles, and it has to be the computer" (reflection, 1992). Sometimes it was helpful for children to work with a hard copy (e.g., database record) before using the computer: "more often than not they work together from some kind of hard copy...if they see it from brain to paper then screen, they're able to do better...it seems for some that it is just too abstract on the screen" (reflection, 1992).

The teacher noticed a difference in depth of understanding when students engaged in inquiry by constructing a database on fairy tales:

> We studied fairy tales before, we've compared...made a chart of each of the qualities of the fairy tales and we've talked through it. But I've never quite seen the same degree of interpretation or understanding or depth of awareness of what a fairy tale is about, because really it is a nice little story; but fairy tales also deal with social and cultural elements...it's a way of teaching the consequences of bad actions, of bad choices...and that came through with the study we did of the fairy tales using the database. They came up with this idea that there is this common thread. Somehow when they see it on the screen it makes some kind of connection. (teacher interview, 1993)

Overall, "the way they think has changed...I can't exactly tell you how, but what I can tell you is that the children in my room who have used the technology in authentic ways...to produce a product that is self-generated...think differently from the children I have taught who have not done similar activities" (teacher interview, 1993).

Working with the technology also gave the students opportunities to develop problem-solving abilities. One of the teacher's goals was for the computer to be a "true source of knowledge...particularly problem-solving skills" (interview, 1991). Students were able to use the knowledge they had to figure out how to work through the software. "They now have the phonic skills to know that their program, LinkWay, has to begin with an 'L,' and they have to have a 'W'...this is where the true practice of the phonetic skills comes into play" (reflection, 1992). Another LinkWay problem-solving episode was captured on videotape and the teacher reflected that a student

> had done this beautiful array of colors and designs, so we printed it out...on the screen it looked really colorful and beautiful but when he got his original he saw that it was just...blackness...darkness. He said, "Oh, I should have left this [area] open. I shouldn't have used so many colors." I thought that was so insightful. Not only did he realize what happens when you use all the colors, he realized what he should have done to correct that for future times..."I need to leave it open." (reflection, 1992)

Students also articulated their problem-solving process. When asked who taught her how to use LinkWay one student replied, "Miss Hughes. She told me a couple of steps and then I learned the rest...by just...pressing buttons and reading the...screen" (interview, 1992). This event was also documented in a log entry (1992).

The computer was not only a thinking tool but also a productivity tool that students used in this classroom in authentic and worthwhile ways. As one first-grader commented, "You can draw pictures and write letters. If you have a pen pal you can write letters to him. And you can write...a card to your mother or grandfather" (interview, 1992). Students in this classroom engaged in several pen pal exchanges and at Christmas, their pen pal was "Santa"! They composed letters to Santa that were answered by seventh graders in a CAGE classroom across town. (See Figure 1) A log entry documents the excitement of students in both classes (1991).

The teacher described changes in the way her students viewed the computers during the school year:

> When they first come into the room, the first thing you hear is, "When are we going to play games?" By the end of the year, not one year have I ever heard them say that again. After they see that the computer really isn't a toy, it's really something that we use to make things happen for us. (interview, 1993)

The teacher modeled use of the computer as a productivity tool by creating word puzzles to support various themed units. She also observed that students' use of the computer as a tool to produce projects became more sophisticated over time: "I see the children coming up with ways of using the technology that aren't at all what I had in mind...they are inventing ways of using it" to "meet their own needs" (interview, 1992).

Adult thinking also changed because of the technology. After participating in the project one year the teacher commented, "I've changed tremendously. First of all I realize that I can step back. I need to sometimes get out of the way and let the children take over so that they can get as much as they can out of an activity" (interview, 1992). This realization is echoed in a log entry (1992). The next year she commented further on changes in her thinking: "I'm a different teacher; the way I teach is different...I know that I'm not the sole source of knowledge now...because of how much the children learn when they use the computer, I am convinced now that I don't have to know it all. My students know far more than I have given them credit for" (interview, 1993). She realized the importance of becoming a learner along with her students:

> I don't know how I missed that before...but it seems to me that those people who have experienced success...in the project are people who have committed themselves to also learning alongside the students. (interview, 1993)

The teacher also predicted parents "will begin to look at computers in a different way too...they will see computers as a tool" (interview, 1993).

The second category within the domain of thought processes included comments about interactions with information. The teacher saw her students "trying to sort things out a certain way...manipulating the information to fit the confines of the computer" (reflection, 1992). In designing a database on famous Black Americans (See Figure 2), the category label students first suggested was too long to fit the database parameters: "the category they wanted was 'how they got famous'...so we had to switch to another word and Billy came up with the word 'accomplishments'" (reflection, 1992; log, 1992). Interacting with information for this database also prompted the need for another category: "Billy said, 'We need to know the date it was invented'...so that we could see if it changed"...they knew that original ideas are good, but then many times people take those ideas and make them even better" (reflection, 1992).

Working on that same database encouraged students to interact with information outside the school setting as they researched the topic. One student visited a local Black History Museum to get needed information (log, 1992). This student connected "the things that he saw and learned at the museum with what was going on in the classroom" (teacher reflection, 1992). The teacher also noticed more persistence in the way some students searched printed texts. She felt with "a variety of

information presented to them in a variety of different ways that they could even surpass where they are now" (interview, 1993). As students developed their research skills and brought information into the classroom, they became more accountable for their learning (log, 1993).

Students used their information to teach others, particularly their parents. Parents wanted to learn what their children know. "I don't know much about computers and...you [child] could show me everything that I need to know" (parent interview, 1992). "She knows more than I do. She could teach me" (parent interview, 1993).

Comments in the third category of this domain addressed increased student achievement. Another of the teacher's goals was to enhance student achievement through the use of inquiry learning with technology. After one year's participation she confidently remarked that this goal had been met (teacher interview, 1992). She particularly noticed that "what they achieved astonished me in many instances...many of the vehicles that they used for learning they developed... themselves...and I just saw that continuously" (interview, 1992). The teacher especially commented on their developing language skills: "They were a lot more verbal. The quality of the exchange between them was really sophisticated in nature" (interview, 1992). Through work with the famous Black Americans database, one student showed growth in reading and writing: "It's been really fun to watch him because he's been much more

willing to try to pull a word apart and decode it or encode it. It's really exciting, the growth that I've seen in him" (teacher reflection, 1992).

Comments supplied by parents indicated they recognized their children's growth in achievement also. One parent felt her son's enjoyment of the computer improved his concentration in school and helped him complete his assignments (interview, 1992). Another parent remarked, "Since working with the computers... she's caught on real easily considering she didn't read a whole lot at the beginning of the year" (interview, 1992). Still another parent described how computer use helped her son with reading and writing "as far as his having to formulate an idea, putting it into the computer and being able to read it back" (interview, 1993).

All types of informants remarked on the changes in thinking that occurred in this inquiry-oriented, technology-rich classroom. Students successfully used the technology as a tool of thinking and productivity. They interacted with information in more varied and sophisticated ways, and the teacher and parents noticed increased achievement. The teacher felt it was not just the technology that made the difference but

> that inquiry base, where the students are asking the questions, and the students are going out and procuring the answers to those questions...when true learning occurs, it's a product of the work that the student does. It's not

> really the product of the work that the teacher does. (interview, 1993)

The teacher projected even greater potential with inquiry learning and technology: "we've really only touched on it, what we do in the room with the equipment at this point, is nothing compared to what they can, or could, do" (reflection, 1993).

Collaboration

Analysis of comments within this domain yielded four general categories: student talk, student choice, sharing, and support. Early in the project, the teacher had planned for students to get "talking between themselves and looking for answers and asking questions" (interview, 1991). Reflecting on a classroom videotape the next school year, she shared her thinking about one role of student talk:

> With the small groups, you definitely get an idea of whether or not it's quality talk...and I find that more often than not they are on task...you have to be careful because sometimes the child who is lying down or who seems too relaxed may really be processing information...might be sitting back thinking about it or sitting back talking to their partner...children process in many different ways in many different positions. (reflection, 1992)

The teacher planned to systematically capture students' talk to better understand their thinking development. These plans were documented in field notes (1992). The teacher also described how students collaborated in making choices:

> They worked always heterogeneously and that was by choice. They didn't automatically go connect with people in a group that had similar academic levels or similar learning styles. Some of the children in the group would be much more artistic, some would be much more verbal, some would be a lot better at listening and offering ideas that way, and they would automatically develop the groups that would meet their needs. (interview, 1992)

Once the students formed their groups, they also chose roles to take:

> What I find is that they pretty much can figure out the different things that need to be done. More often than not, I do not specify what...each person needs to do. They know that they've got to come up with this end result, and then they...come up with this division of labor on their own. (teacher reflection, 1992)

Instances of self-initiated division of labor were also recorded in the teacher log (1991).

Students monitored their own progress; they would "remind each other of the job, keeping each other on tab" (teacher reflection, 1992). Sometimes groups made collaborative decisions regarding inquiry content, such as choosing which fairy tale they wanted to read and research (teacher reflection, 1993).

Important aspects of collaborative work involved help with keyboarding skills, the sharing of ideas, and taking turns. A student commented that "we get to work in groups...share and do

stuff together" (interview, 1992). When asked how she liked writing at the computer, one student said "it was fun because you got to use partners, and they helped you...they would type in the sentences when you tell them the letters" (1993). Other instances of students helping each other (e.g., pointing out needed keys on the keyboard) were documented in log entries (1991) and field notes (1992).

Working together at the computers, students also helped each other by sharing their ideas: "when one child makes that discovery, the other children pick up on that discovery and they either share it by talking about it or...by just observing" (reflection, 1993).

> Students became more patient with turn-taking:
>
> In the beginning there was this concern whether or not they would get their turn and now there isn't that same concern. They know that when their classmate finishes, it will be their turn. They still ask, "Can I go next?" It's not the same urgency. It's as if they almost know "well if I can't go next, I'll be going soon." They are...learning to be patient. (reflection, 1992)

Students were also aware that "sometimes we take turns typing" (interview, 1993). A parent offered this comment about the opportunities to share turns:

> I guess having the computer gives you more chance for interaction...it's more accessible when it's up on the screen...and they can even take turns pressing the button or

whatever, to change it over, to get the text that they want. (interview, 1993)

Collaboration appeared to increase peer-support: "they're just so much more supportive...all starting out at the same level, and then you see these strengths developing in certain program uses...and the children automatically go to those people for help and support" (teacher reflection, 1992). Arrangement of the computers was a factor in developing this peer-support: "with the desks sideways...they have the support from the other people now. They can help each other. When they were back-to-back they were too isolated" (teacher reflection, 1992).

The teacher noticed changes in student interaction during inquiry work with the computer: "These children really developed a family connection, respect for each other's ideas" (interview, 1992). The teacher felt when students "begin to use the technology...they collaborate differently. They work together, they have a common...focus or goal. They are there to provide support for each other" (interview, 1993).

Changes in collaboration extended to the parents also. The teacher felt parent involvement had improved: "now parents who were not previously involved are asking ways that they can help their children better as they've seen how their children have...evolved from meeting the goals of the project" (interview, 1992). Parents also commented that their children worked together with computers at home (1993).

Collaboration with another CAGE teacher was deemed important. In reference to a cross-grade fable project the teacher commented, "I think the idea that teachers are connecting and seeing what each grade level has to offer...first of all the students connecting and then those two teachers connecting... represents success" (interview, 1992). Another benefit of on-going collaboration might be the shared purchase of software or hardware needed for various joint projects. Because she felt peer-collaboration was so important, the teacher called for district-wide support: "we have to convince the Board...our principals...time to collaborate and share...needs to be expanded" (interview, 1993).

Attitude

Analysis of comments within this third domain yielded two categories, confidence and interest. Increased confidence was frequently recorded in the teacher log (1992; 1993). As students became more confident using the technology to share inquiry findings, they described it as being easier than conventional ways saying "the computer was easier" and "it doesn't hurt your hands like the pencil" or "I don't get tired when I keep on having to write" (interviews, 1992). Parents also observed this sense of the task being easier. One felt when her son wrote stories or poems with the home computer it "was easier for him to change if he didn't like it" (interview, 1993).

Students not only appeared confident with the technology but also appeared comfortable with not knowing all the answers. The teacher found they were

> just so confident of what they know, and what they don't know--they're secure enough with that too. They know that "if I don't know it today" that "I can do something about that"...I've found that to be remarkable for first grade. (interview, 1992)

Increased confidence was also expressed as increased willingness to take risks. The teacher described one student as

> a lot more adept in her reading and writing and her willingness to take a risk with particular things like the invented spelling and even the material she tackles now...she just doesn't want to read only the...familiar...she wants to read a lot of the new material. (reflection, 1993)

Risk-taking was a factor of the teacher's development also. Early in the project, the teacher felt one key to success was "how able the teacher is to take risks" (interview, 1991). She expressed concern because "there is such a great risk of failure in this project, how we'll look in front of the kids...not being able to solve a problem, and that can be intimidating for some people" (interview, 1991). The following year she commented on the yielding of control as the teacher learns alongside the students (reflection, 1992). Another year later she described a

different dimension of risk-taking induced by more sophisticated computer capabilities:

> I think that we should also be taking risks in figuring out better ways to use that technology...one of the things that I am definitely going to do is the multi-media...so I'm risking that this equipment is going to do all of the things that it is supposed to do, but I am also risking that my first graders can make it do those things, because the research seems to say that...the starting age seems to be second grade. (interview, 1993)

Her confidence in her students' capabilities is strong because even though "research is supporting that second grade is about the earliest that this [multi-media] works, but I'm just convinced...that my first graders can do that and...a lot better" (interview, 1993).

As confidence grew, so did the teacher's comfort in using inquiry learning with technology. This is dramatically shown through the teacher's self-assessment data. Each year she indicated she was more comfortable sharing the planning and evaluating of learning with the students and tackling new problems with the computer. (See table 3)

Student self-esteem grew as they gained confidence using inquiry learning with technology. They earned respect from people in other classrooms and "you could see them...beaming as their projects were hung on the wall...they were really proud of it and if someone had a question, they'd be the person who would

explain what we did and how we did it" (interview, 1992). Each year parents echo this observation: "he's real proud of it. He wants to print things up" (interview, 1992); "he got really excited, proud to see his art work and what his thought or feelings were on the subject. Everyone could see...he really enjoyed that" (interview, 1993).

Comments in the second category in this domain addressed increased interest in school and with the technology itself. Parents frequently attributed increased interest in school to interest in the computer:

> It's not like work to them. It's more like they are learning and playing at the same time; he's more interested in...doing his work; she seems so interested in everything she does there [school] now. She's going around telling everybody in the family "I'm smart now. I can do this and that." (interviews, 1992)

Similar remarks were made in 1993 interviews: "he is a very good reader. It just makes it more interesting...especially when he can manipulate what he is working with"; "he really wanted us to get one [computer]...it's sparked him, I guess" (interviews, 1993).

Parents reported that students talked about computers at home: "he talks about computers all of the time. I'm thinking about getting one in the house because he likes it so much" (interview, 1992). Parent remarks indicated that students valued their time on the computers in the classroom: "he would come

home when he had his time on the computer and just tell me that...'I got to use the computer today'...he thought that was pretty cool, I guess...he really likes it" (interview, 1993).

Discussion

Results of this study describe ways inquiry learning in a technology-rich classroom impacted the thinking, social interaction, and attitudes of those engaged in it. Comments on thought processes and collaboration were jointly supplied by the teacher, students, and parents. Together these comments contributed more than 3/4 of the data for this study, indicating that changes in thinking and collaboration were evident both to those who daily participated in the classroom activities and to the parents in the home.

Technology itself appeared to be a factor in the development of student thinking. Students seemed better able to conceptualize ideas and solve problems for themselves. They manipulated information differently to fit the confines of computer software applications (e.g., character limit for database fields), supporting Olson's (1989) suggestion that computers alter the way students think.

Technology was not the only factor, however. It was through the inquiry process that students interacted with information to greater depth and recognized other sources of knowledge beyond books and the teacher. It was through the inquiry process that the students took ownership of their learning by asking questions and finding answers. It was through the inquiry process that

students saw a need to work together and successfully formed groups to accomplish a task. In this classroom, at least, there is strong indication that the combined use of inquiry learning and technology yielded "phenomenal" changes in the way students think and work together. This finding supports earlier research on ways computer environments enable students to maximize their thinking (Scardamalia, et al., 1989).

The use of inquiry learning and technology yielded benefits for the teacher also. For this teacher, peer collaboration was a necessary support; she frequently commented on the need to "bounce ideas off of another teacher" (log, 1992). Changes in her role were another benefit. She decided to share responsibility for the planning and evaluating of learning activities with her students and to relinquish her position as "sole source of knowledge."

In addition, the inquiry process with technology provided an opportunity for this teacher to see her students thinking and working differently. It was the inquiry process that drove computer use beyond "skill and drill" exercises. Initially, the teacher had asked for software "appropriate for first grade use"; yet after only a few months' participation in the project she realized it wasn't more software they needed but more ideas for using the word processor, database, and multi-media applications they already had (log, 1992). Clearly, she saw the power of technology not as an inherent component of the hardware or

software, but as a factor of the users' ability to implement that power to the fullest extent.

Several themes are apparent across domains. Comments about student confidence included references to self-initiated computer use. Students confidently knew what the computer could do and how it could help them accomplish things; for example, one year the class decided to use the technology to make a surprise banner for their teacher on her birthday (log, 1992). The students were also confident about forming groups and deciding how to share responsibility for their assignments. Further, their confident attitude was expressed through increased interest in school.

Another theme that appears in all domains is the merging of teacher and learner roles. As the students worked with the technology to inquire into topics of their interest, the teacher realized the need to step back and give the students opportunity to plan and direct their own learning. By stepping back, the teacher began to learn alongside her students, and the students began to teach each other. This finding substantiates the idea that only as teachers become learners within a community of learners is the full potential of computers realized (Hawisher & Selfe, 1991). In this classroom, the roles of teacher and learner were not discrete entities but interdependent processes.

Several conclusions may be drawn from these findings. The implications of these conclusions inform current classroom practice and give direction to further research.

1. Technology alone had limited impact on student thinking; it was the inquiry approach that maximized technology as a thinking tool. For those planning to install computer technology, whether at the classroom, building, or district level, decision-making must not stop with cabling and software options; it must extend to consideration of an instructional approach that maximizes student thinking and collaboration.

2. As a result of engaging in their own research, students begin to see natural connections between curricular areas. When children engage in inquiry learning with technology, they do the integrating themselves. When developed naturally through the students' learning, integrated curriculum does not need to be imposed from without; because of its authenticity, it may also be more effective than reliance on published materials packages. This also suggests inquiry learning should be included in teacher inservice on integrating curriculum.

3. Inquiry learning in a technology-rich environment favorably impacts student thinking as described in this study. Further research is needed, however, to systematically assess growth in thought processes both quantitatively and qualitatively.

4. The merging of traditional teacher and student roles is an important aspect of inquiry learning with technology. Students recognized each others' talents and abilities and willingly shared their information. This was reflected in the homes also as parents commented that their children "know more"

and "teach them." It is important, then, for classrooms to provide opportunities for this merging of roles to occur.

5. Collaboration is another important aspect of inquiry learning with technology, and it impacts both the students and the teacher. Student talk needs to be documented and studied to deepen understanding of thought processes and the nature of social interaction between students. Teacher collaboration needs to be encouraged and supported (e.g., providing time for collaborative planning within the school day) by the administration and community.

6. The confident attitude toward computers and inquiry learning that was evident in both the school environment and home setting promoted increased interest in school overall. A need to engage students in technology beyond "skill and drill" exercises is indicated.

Conclusions

This study sought to describe the impact of inquiry learning in a technology-rich environment from the perspective of those most actively involved--the students, the teacher, and parents. Using this "insider" lens provided a sociocultural view of the learning and teaching in one first grade classroom over a two-year period.

Though the inquiry learning and technology were shown to favorably impact student learning in several important ways, the changes shown in the teacher's thinking are perhaps of greater importance. "I have always had high expectations...I've always

known that they could know more than what the curricula say our first graders should know" (teacher interview, 1993). Inquiry learning in a technology-rich environment gave evidence and credence to this belief. It provided a vehicle for classroom change by supporting learning and teaching in dramatic ways.

As a basis for educational reform, the changes in the teacher's views--of her students as co-planners and evaluators of learning activities and of herself as learner--were critical. Educational reform efforts must reach far beyond modifications of the learning environment; they must embrace a different view of students, one that recognizes and respects the many ways that students think and learn.

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Table 1

Comments on Domains as Percentage of Total

Domain	Teacher	Students	Parents
Thought processes	46%	6%	4%
Collaboration	16%	3%	2%
Attitude	7%	3%	13%

Table 2

Changes in teacher perceptions by domain

Domain	Year 1	Year 2	Year 3
Thought processes	Motivation of technology itself; integration with curriculum; development of inquiry process; student recognition and use of multiple sources of knowledge	Technology integrated with the curriculum made it "click" for students; enhanced student achievement; students initiated uses of technology; teacher stepped back	Inquiry learning with technology a strong factor; systematically evaluate student thinking; technology as compensation for limited reading proficiency; increased teacher recognition of student knowledge; teacher as learner
Collaboration	Planned for student collaboration; importance of teacher collaboration	Students worked in small groups and with partners; students formed heterogeneous groups by choice; importance of student talk more apparent; increased parent involvement	Need to capture student talk on tape; increasing importance of teacher collaboration
Attitude	Excitement with the technology; expected to become more comfortable	Students confident; teacher more comfortable but still needs to grow	Increased student interest in school and technology

Table 3

Teacher Self-Assessment

Responses to these items indicated increased inquiry learning over a 3-year span:

- Students share responsibility for planning and evaluating their learning activities
- Self directive behavior is encouraged and systematically developed through shared responsibility for planning, evaluation, and decision-making

Responses to these items indicated increased comfort with technology over a 3-year span:

- Working with a computer would not make me nervous
- Computers do not make me feel uncomfortable
- Generally I would feel OK about trying a new problem on a computer
- I have a lot of self-confidence when it comes to working with computers

DEAR SANTA,

I LIKE YOU. THIS IS

WHAT I WANT FOR

CHRISTMAS : FAST

TRACK, SUPER NINTENDO, A

BATMAN SUIT, A TWELVE

SPEED BIKE.

LOVE,

PEDRO

122591 CANDY CANE LANE
NORTH POLE.54321,
DECEMBER,16 1991

DEAR PEDRO,

HO,HO,HO,MERRY CHRISTMAS! HELLO DO YOU ALL BELIEVE IN SANTA CLAUS? IF YOU DO,YOU WILL HAVE FUN SHOWING OTHER PEOPLE THE WAY OF SANTA OR THE WAY OF GIVING.IF YOU DON'T BELIEVE IN SANTA CLAUS MANY PEOPLE WILL SHOW YOU THE WAY OF GIVING. CHRISTMAS IS NOT JUST GETTING TOYS LIKE A FAST TRACK,A SUPER NINTENDO,A BATMAN SUIT,OR A TWELVE SPEED BIKE. CHRISTMAS IS ABOUT GIVING.I'M SURE IF YOU ARE REAL GOOD AND NOT NAUGHTY YOU WILL GET MUCH OF WHAT YOU'RE WISHING FOR. ON DANCER,ON PRANCER! HO,HO,HO,MERRY CHRISTMAS!

SINCERELY,
SANTA CLAUS

Figure 1

FAMOUS BLACK PEOPLE

NAME: GEORGE GRANT

BORN:

DIED:

ACCOMPLISHMENTS: THE GOLF TEE KEEPS DIRT FROM FLYING IN YOUR EYES. THE GOLF TEE HELPED TO NOT MAKE A HOLE IN THE GROUND.

IMPACT: GOLFING IS MADE EASIER BECAUSE YOU DON'T MAKE HOLES IN THE LAND. IF YOU OWNED A GOLF COURSE, YOU DON'T HAVE TO GO OUT AND SMOOTH THE LAND FOR THE NEXT GAME.

FAMOUS BLACK PEOPLE

NAME: SARAH BOONE

BORN:

DIED:

ACCOMPLISHMENTS: SHE MADE THE IRONING BOARD. IT IRONS CLOTHES PEOPLE PUT THE CLOTHES DOWN ON THE BOARD. IT I SQUARE AND ROUND SHAPED.

IMPACT: THE IRONING BOARD HELPS PEOPLE WHO DON'T HAVE WASHERS AND DRYERS TO DRY THEIR CLOTHES. IT MAKES IT EASIER AND FASTER TO IRON CLOTHES

FAMOUS BLACK PEOPLE

NAME: JOSEPH H. SMITH

BORN:

DIED:

ACCOMPLISHMENTS: HE INVENTED THE LAWN SPRINKLER.

IMPACTS: THE PEOPLE CAN RUN THROUGH THE SPRINKLER IN THE YARD. THEY WILL NOT GET HOT. THE SPRINKLER LETS OUT MORE WATER THAN A WATERING CAN. THIS WILL KEEP THE GRASS AND FLOWERS FROM DYING. THE TREES WILL NOT DIE BECAUSE THE WATER IS SPRINKLED ON THEM.

COMMENTS: IF THE TREES DIED, THEN WE WOULD DIE, TOO.

Figure 2